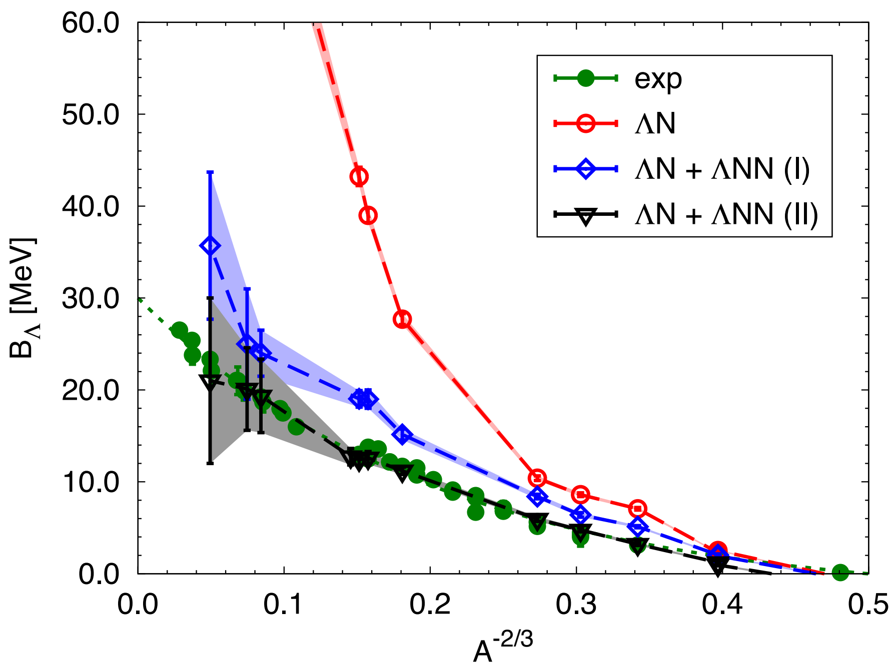
From hypernuclei to hypermatter: the role of three-body forces

Objectives

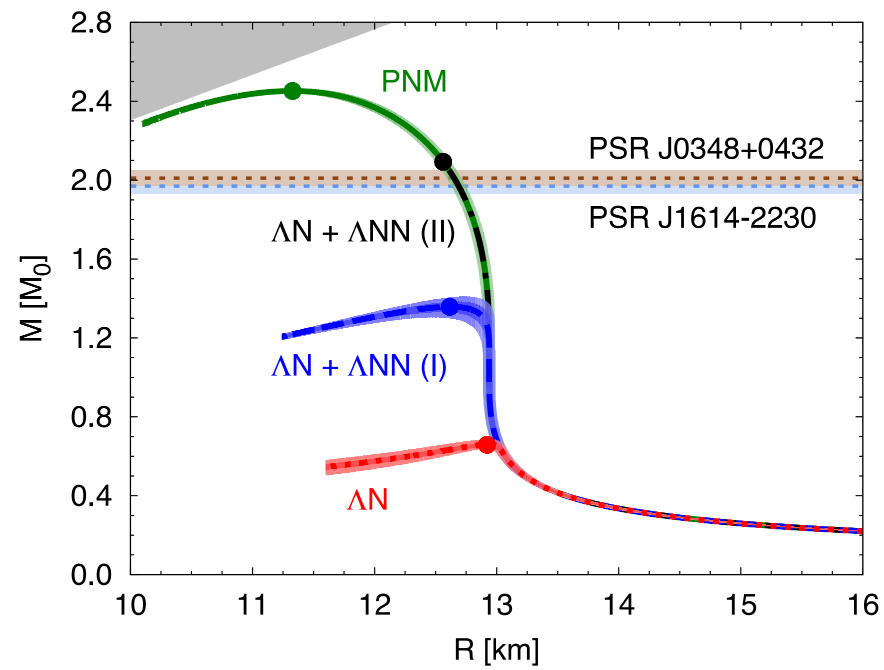
- Study the ground state properties of Λ-hypernuclei over a wide mass range ($3 \leq A \leq 91$).
- Investigate the effect of the presence of hyperons in the inner core of neutron stars.
- Calculate the equation of state of pure neutron matter in presence of Λ hyperons by using realistic nucleon-nucleon and hyperon-nucleon forces.

Impact

- Extension of ab-initio calculations to the strange nuclear sector.
- Provide the directions for future theoretical investigation and for the next generation of terrestrial hypernuclear experiments.
- New hints for the solution of the so-called *hyperon puzzle*: connection between the theory of baryon-baryon interaction and astrophysical observations.



Hyperon separation energy. The inclusion of three-body hyperon-nucleon forces provides a good description of the ground state physics of Λ-hypernuclei over a wide mass range.



Mass radius relation. Different models of three-body hyperon-nucleon force predict dramatically different results on the maximum mass of neutron stars.

Accomplishments

- Development of quantum Monte Carlo methods to explore nuclear systems with hyperons.
- Improvement of existing realistic hyperon-nucleon Hamiltonians.
- Point out the need of additional hypernuclear experimental input and further theoretical studies.

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References: Phys. Rev. C 89, 014314 (2014)
Phys. Rev. Lett. 114, 092301 (2015)

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